Executive Office of Environmental Affairs

Massachusetts Office of Technical Assistance

Fact Sheet

Reporting Respirable Crystalline Silica

Respirable Crystalline Silica is a TURA Chemical:

On January 22, 2002, the Toxics Use Reduction Act (TURA) Administrative Council voted to list crystalline silica as a TURA reportable chemical with the following qualifiers: (1) applies only to crystalline silica (vs. gel, fused, or other forms of amorphous silica) particles less than 10 micrometers in diameter; and (2) applies only to sand blasting and/or foundry molding operations.

If your facility's respirable crystalline silica use meets these qualifiers and your facility meets the guidelines outlined under "Who Must File a TURA Form S?", then you will need to submit a complete Toxics Use Report (Form S) to the Massachusetts Department of Environmental Protection (DEP). ***Since calendar year 2002 is the first year that respirable crystalline silica is reportable, Form S reports for 2002 use are due by July 1, 2003.***

Why the Concern Over Crystalline Silica?

Silica is a naturally occurring mineral that makes up over 12% of the earth's crust by volume. Although there are many forms of silica (e.g. fumed, fused, crystalline, or gel), the silica found in quartz, tridymite, cristobalite, and tripoli is a crystalline form that can cause significant and irreversible health problems for exposed workers.

When a worker inhales crystalline silica dust it can be deposited into the tiny air sacs of the lungs. While larger particles are easily filtered out from the lungs, smaller particles – those with a diameter of less than 10 micrometers – tend to settle in the lungs and are considered "respirable" particles. Once in the lungs, respirable crystalline silica tends to form scar tissue, creating a condition known as silicosis.

Silicosis is not a naturally occurring disease; it can be severely debilitating and sometimes fatal. However, silicosis can be prevented. The severity of the disease is related to the total amount of respirable crystalline silica inhaled. The International Agency for Research on Cancer (IARC) designated respirable crystalline silica as a Group 1 human carcinogen, i.e., it is known to cause cancer in humans. The risk of developing lung cancer from crystalline silica exposure is proportional to the total amount and frequency of respirable crystalline silica inhaled.

Who Must File a TURA Form S for Crystalline Silica?

Under the reporting requirements, a facility must file a Toxics Use Report (Form S) for respirable crystalline silica if it meets ALL THREE of the following criteria:

1. Has one of the following SIC codes: 10-14, 20-40, 44-51, 72, 73, 75, or 76; and performs sand blasting and/or foundry molding operations; AND
2. Has 10 or more full-time employees or the equivalent of 20,000 hours per year; AND
3. Manufactures (including imports) or processes 25,000 pounds or otherwise uses 10,000 pounds per year or more of respirable crystalline silica, (particles less than 10 micrometers in diameter).

Reporting Respirable Crystalline Silica:

The amount of respirable crystalline silica that is manufactured (including coincidental manufacture), processed or otherwise used must be accounted for to determine if a facility meets reporting thresholds.

If the reporting threshold is exceeded, a Toxics Use Report, including a state-only EPCRA TRI Form R, must be prepared and submitted to the Massachusetts DEP. Since respirable crystalline silica is not currently on the EPCRA 313 list, ***no forms should be sent to the federal government***.

An example to determine if a threshold has been exceeded is included at the end of this fact sheet.

Respirable Crystalline Silica De Minimis:

TURA regulations provide an exemption for reporting in the case where the regulated chemical is present in de minimis quantities in a compound or mixture. The de minimis thresholds are 1% by weight for non-carcinogens and 0.1% by weight for IARC-listed carcinogens. The de minimis for respirable crystalline silica is 0.1%. The exemption does not apply to the manufacture or coincidental manufacture of a TURA reportable chemical.

Contact the Massachusetts Department of Environmental Protection to request a TURA Form S reporting package at 617-292-5582 or www.mass.gov/dep/bwp/dhm/tura/turapubs.htm

Measuring Respirable Crystalline Silica:

The quantity of silica must be determined for each activity – manufacture, process, or otherwise use at the facility. ***It is recommended that facilities use the best readily available data to determine if reporting is applicable for their operations.*** Where such data are not readily available, facilities should use reasonable estimates. No additional monitoring or measurement of the quantities of any TURA chemical is required for the purpose of completing Form S.

Some suggested methods of measuring respirable crystalline silica follow.

Data Sources to Determine Quantity Used

1. Particle size distribution data from the sand supplier or a laboratory providing such analysis.
2. Data from sieve analysis or other in-house process quality control techniques.

Determining Byproduct or Shipped as Product

1. Review air permits and air emissions inventories for facility-specific monitoring data, e.g. control equipment sampling and capture efficiencies.
2. Review solid waste records, e.g., a nonhazardous waste manifest, or MA99 form.
3. Use published emission factors where available; note some factors may not be reliable.

Lab Services for Respirable Crystalline Silica Analysis:

The following laboratories will provide analyses of the weight percent of respirable crystalline silica in a sample of sand; costs range from approximately $100-$300 per sample. The laboratories may also provide guidance on the protocol for collecting a sample for analysis. The vendor information provided below is for the user's convenience only. OTA does not endorse the vendors or their services.

Clean Air Engineering, Inc.
50 West Wood Street
Palatine, IL 60067
800.627.0033
contact name: Doug Rhoades
e-mail: drhoades@cleanair.com

Liberty Mutual Industrial Hygiene Lab
71 Frankland Road
Hopkinton, MA 01748
800.230.6263 x364
contact name: Ken Muzal
e-mail: Kenneth.Muzal@libertymutual.com

Particle Technology Labs, Ltd.
555 Rogers Street
Downers Grove, IL 60515
630.969.2745
contact name: Amy Ganden
e-mail: experts@particletechlabs.com

Example: Foundry Molding Operation with Abrasive Blasting

The example below provides guidance on how a facility would calculate TURA thresholds for respirable crystalline silica. The weight percent of respirable crystalline silica may not be representative of a facility's actual production conditions, i.e. weight percents may be higher or lower than those presented. Facilities are advised to review particle size distribution data from the sand supplier to determine whether respirable crystalline silica is present in amounts exceeding the de minimis threshold (0.1% by weight).

A Massachusetts foundry uses sand in their casting operations. In calendar year 2002 the company purchased and used 5,000,000 lbs of casting sand. Of this amount, 4,994,800 lbs of spent sand was shipped to a local sanitary landfill to be reused as landfill cover.

- Data from the casting sand supplier indicates the sand contains 98% crystalline silica (as quartz) and that 0.5% by weight of the sand is below U.S. mesh 270 (53 micrometers).
- Particle size analysis yields 0.05% by weight of the casting sand as received is less than 10 micrometers (0 lbs).
- Analysis of a sample of the 4,994,800 lbs of spent sand sent shipped off-site for reuse shows 0.15% by weight is less than10 micrometers (7,342 lbs).
- An average of 100 pounds per week of baghouse dust is collected. Analysis of representative samples from the bag house shows a weighted average of 15.5% is less than 10 micrometers (790 lbs).

The facility also uses 75,000 lbs per year of 99.6% crystalline silica sand for abrasive blasting.

- 0.12% by weight of the sand as received is less than 10 micrometers (90 lbs); it is not reused.
- Spent abrasive blasting sand analysis shows 25% by weight is less than 10 micrometers (18,177 lbs).
- A second baghouse collects 2,000 lbs of abrasive blasting dust over 1 year, which is shipped off-site as waste. Analysis of this dust shows 25% by weight is less than 10 micrometers in diameter (498 lbs).

Does the facility trip manufacture, process, or otherwise use thresholds for respirable crystalline silica?

OTHERWISE USE OF RESPIRABLE CRYSTALLINE SILICA:

- **Foundry Molding Operations, respirable crystalline silica as received:**
  Respirable fraction meets the de minimis threshold for respirable crystalline silica, 0.1% by weight. Since de minimis quantities are not counted toward the threshold, this value is **0 lbs/yr**.

- **Abrasive Blasting Operations, respirable crystalline silica as received:**

  $$\frac{75{,}000 \text{ lbs abrasive sand}}{\text{yr}} \times \frac{0.0012 \text{ lbs respirable abrasive sand}}{\text{lb abrasive sand}} \times \frac{0.996 \text{ lbs crystalline silica}}{\text{lb respirable abrasive sand}} = \mathbf{\frac{90 \text{ lbs}}{\text{yr}}}$$

  Total otherwise use of respirable crystalline silica:

  $$\frac{0 \text{ lbs}}{\text{yr}} + \frac{90 \text{ lbs}}{\text{yr}} = \mathbf{\frac{90 \text{ lbs}}{\text{yr}}}$$

  Facility otherwise uses 90 lbs per year of respirable crystalline silica. Reporting threshold for otherwise use is not exceeded.

COINCIDENTAL MANUFACTURE OF RESPIRABLE CRYSTALLINE SILICA:

- **Foundry Molding Operations, respirable crystalline silica from spent sand:**

  $$\frac{4{,}994{,}800 \text{ lbs casting sand}}{\text{yr}} \times \frac{0.0015 \text{ lbs respirable casting sand}}{\text{lb casting sand}} \times \frac{0.98 \text{ lbs crystalline silica}}{\text{lb respirable casting sand}} = \mathbf{\frac{7{,}342 \text{ lbs}}{\text{yr}}}$$

- **Abrasive Blasting, respirable crystalline silica from spent sand:**

  $$\frac{73{,}000 \text{ lbs abrasive sand}}{\text{yr}} \times \frac{0.25 \text{ lbs respirable abrasive sand}}{\text{lb abrasive sand}} \times \frac{0.996 \text{ lbs crystalline silica}}{\text{lb respirable abrasive sand}} = \mathbf{\frac{18{,}177 \text{ lbs}}{\text{yr}}}$$

- **Baghouse/Dust Collection Systems:**

  $$\frac{5{,}200 \text{ lbs baghouse dust}}{\text{yr}} \times \frac{0.155 \text{ lbs respirable sand}}{\text{lb baghouse dust}} \times \frac{0.98 \text{ lb crystalline silica}}{\text{lb respirable sand}} = \mathbf{\frac{790 \text{ lbs}}{\text{yr}}}$$

  $$\frac{2{,}000 \text{ lbs baghouse dust}}{\text{yr}} \times \frac{0.25 \text{ lbs respirable sand}}{\text{lb baghouse dust}} \times \frac{0.996 \text{ lb crystalline silica}}{\text{lb respirable sand}} = \mathbf{\frac{498 \text{ lbs}}{\text{yr}}}$$

  Total coincidental manufacture of respirable crystalline silica:

  Total coincidental manufacture of respirable silica = coincidental manufacture from molding plus abrasive blasting plus baghouse dust minus what came in with the sand product.

  Molding + abrasive blasting + baghouse dusts – (came in with product) = Coincidental Manufacture

  $$\frac{7{,}342 \text{ lbs}}{\text{yr}} + \frac{18{,}177 \text{ lbs}}{\text{yr}} + \frac{790 \text{ lbs}}{\text{yr}} + \frac{498 \text{ lbs}}{\text{yr}} - \frac{90 \text{ lbs}}{\text{yr}} = \mathbf{\frac{26{,}717 \text{ lbs}}{\text{yr}}}$$

Facility coincidentally manufactures 26,717 lbs respirable crystalline silica. Reporting threshold is exceeded.

Form-S is completed as follows:

1.2a	*Manufactured*	*26,717*	*1.2d*	*Generated as Byproduct*	*19,465*
1.2b	*Processed*	*0*	*1.2e*	*Shipped in or as Product*	*7,342**
1.2c	*Otherwise Used*	*90*		**byproduct as product – sand reused for landfill cover*	

If the facility were reporting another TURA chemical, then the coincidental manufacture (Manufactured) threshold would drop from 25,000 lbs to 10,000 lbs.

Note: For facilities that recycle sand, recycled sand is not counted as byproduct.

TUR Techniques to Reduce Respirable Crystalline Silica Use and Exposure:

Engineering controls, good housekeeping, and worker training are all necessary for controlling employee exposures to respirable crystalline silica. Good housekeeping and worker training are low investment TUR techniques for reducing respirable crystalline silica use. The following suggestions may potentially be higher cost TUR options, but may also reduce other costs associated with using an OSHA and TURA regulated chemicals.

Foundry molding operations:

Although green sand molding is often considered the cheapest molding technology, other technologies with the potential to reduce respirable crystalline silica exist. Alternative casting methods such as vacuum molding and lost investment casting offer completely different approaches to creating the mold. Alternative molding materials are also under development, which may reduce or replace crystalline silica. The complexity of the casting, size, and other factors must be considered in evaluating these options. More information is available from the U.S. Department of Energy at: http://www.oit.doe.gov/metalcast/pdfs/profile.pdf

Abrasive blasting:

The National Institute for Occupational Safety and Health (NIOSH) conducts research into occupational safety and health issues, and makes recommendations on methods to prevent and reduce workplace hazards and exposures. They are evaluating possible substitutes for crystalline silica in abrasive blasting. In December 2001, NIOSH made a recommendation to the National Toxicology Program to further investigate the following materials to determine their suitability as alternatives to crystalline silica:

- Coal slag
- Specular hematite
- Steel grit
- Crushed glass
- Garnet

NIOSH has chosen not to further evaluate nickel slag, copper slag, olivine, and staurolite because previous studies showed high airborne metals concentrations, potential to induce tumors in rats, or respirable crystalline concentrations above the NIOSH recommended exposure level. The study is at http://www.cdc.gov/niosh/pdfs/ab_p3rep.pdf

Organic materials such as walnut shells and corncobs are also possible substitutes. Note that hardness specifications for the abrasive and the desired degree of surface cleanliness and roughness will ultimately determine which, if any, alternatives are technically feasible.

Avoid Occupational Exposure to Respirable Crystalline Silica:

OSHA regulates respirable crystalline silica by setting Permissible Exposure Limits (PELs) under the Air Contaminants Standard, 29 CFR 1910.1000.

OSHA requires employers to take appropriate steps to prevent or limit employee exposure to respirable crystalline silica. The methods below may help limit exposures.

Engineering controls:

- Always use local exhaust or booths with properly designed and operated ventilation.
- Process areas that generate respirable crystalline silica should have particulate control equipment with the appropriate capture efficiency.
- NIOSH recommends different equipment for different concentrations of silica. Use appropriate NIOSH approved respiratory protective equipment.

Good house keeping:

- Maintain equipment, vacuum and wet sweep floors, and vacuum and remove settled dust from clothing and the workplace.
- Where vacuuming is done, use equipment with HEPA (high efficiency particulate air) filters; otherwise wet sweep the area.

Worker training:

- Provide workers with annual fit tests for respirators, and training on how to maintain and clean respiratory protective equipment.
- If a respirator is on site, then OSHA requires a written respiratory protection program to be in place.
- Provide educational materials on silicosis to sand blasters and others with potential exposure.

OTA Assistance Services

The Office of Technical Assistance (OTA) provides one-on-one technical assistance on pollution prevention (P2), toxics use reduction (TUR) and compliance – as well as guidance in the form of workshops, case studies, manuals and other materials. OTA helps toxics users in Massachusetts to identify TUR/P2 opportunities within their operations and initiate planning efforts. Contact OTA at:

251 Causeway Street, Suite 900, Boston, MA 02114
Phone: (617) 626-1060 or on-line at
www.mass.gov/ota